Answers to Scott's Exam
Multiple Choice

1. d) the slope of the d-t graph at t=0 is negative, therefore the initial velocity must be <0; the value of the a-t graph is positive and constant, therefore the v-t graph must be linear and the slope must be greater than zero.

2. Answers:

   (a) is wrong because the statement under the second law implies that F = m = a.

   (b) is clearly wrong

   (c) is correct

   (d) is clearly wrong

   (e) is wrong because the statement under the first law is not necessarily true

3. Answer: You must first determine that 1.00 L of water is 1.00 kg
   $m_s c_s \triangle t_s + m_w c_w \triangle t_w = 0$
   $(0.500kg)(2.33x10^2 \frac{J}{kg \cdot {}^\circ C})(t_f - 215^\circ C) + (1.00kg)(4.18x10^3 \frac{J}{kg \cdot {}^\circ C})(t_f - 10^\circ C) = 0$
   $t_f = 15.6^\circ C$

4. the fundamental frequency of an open air column is
   $\frac{1}{2}\lambda$which = 3.6 m, therefore $\lambda = 7.2m$
   $v = f\lambda = \frac{346\frac{m}{s}}{7.2m} = 48hz$

5. a)

Extended Answer

1. $d_a = (2\frac{m}{s})(3min)(60\frac{s}{min}) + (5\frac{m}{s})(3min)(60\frac{s}{min}) + (1\frac{m}{s})((t-6)min)(60\frac{s}{min})$
   $d_b = (2\frac{m}{s})(t)min(60\frac{s}{min})$
   His efforts would be unproductive when the distances are equal, which works out to 2km (when you round to the appropriate significant digits).

2. Must convert 130 km/h to 36.1 m/s.
   $a = \frac{F}{m} = \frac{150kN}{140kg} = 1071\frac{m}{s^2}$
   $v^2 = v_o^2 + 2a(x - x_o)$
   $0 = (36.1\frac{m}{s})^2 + 2(-1071\frac{m}{s^2})(x - 0)$
   $x = 61cm$

3. Answer:

   (a) $E_{in} = W = Fd = (250N)x(37m) = 9250J$

   (b) $E_{out} = mgh = (41kg)(9.8\frac{m}{s^2})(22m) = 8839J$
   $Eff = \frac{E_{out}}{E_{in}}x100 = 96\%$

(c) heat or sound are typical answers

4. Many answers are possible: energy waves caused by earthquakes can cause buildings to collapse; engineers can design energy absorbing designs into buildings like those in San Fransisco; ultrasound uses waves; helps by allowing medical staff to take internal images of patients to assist with diagnoses.

5. Answer:

   (a) $R_1 = 1\Omega + 2\Omega$, therefore $I_1 = \frac{6V}{3\Omega} = 2A$, therefore $V_1 = I_1 R = 2A \cdot 1\Omega = 2V$
   $R_2 = (\frac{1}{6\Omega} + \frac{1}{6\Omega})^{-1} + 3\Omega$, therefore $I_2 = \frac{V}{R_2} = \frac{6V}{6\Omega} = 1A$, therefore $V_2 = I_2 R = 1A \cdot 3\Omega = 3V$
   $I = I_1 + I_2 = 2A + 1A = 3A$

   (b) $P = VI = 6V \cdot 3A = 18W$
   =20W when accounting for significant digits.